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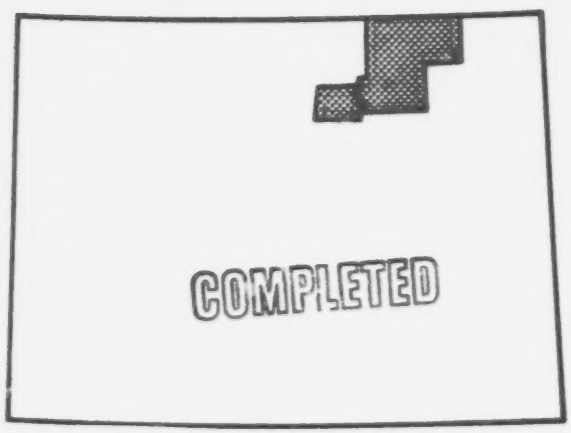
FLOOD INSURANCE STUDY

TOWN OF ERIE, COLORADO
BOULDER AND WELD COUNTIES



REVISED: SEPTEMBER 28, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 080181

AC

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the Town of Erie, Colorado. This information will be used by the Town of Erie to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The hydrologic and hydraulic analyses for the area north of Perry Street, dated April 1978, were performed by Gingery Associates, Inc., for the Federal Insurance Administration, under Contract No. H-4017. Subsequent refinements of this hydrologic and hydraulic data were developed by Water Resources Consultants, Inc., in August 1980, and Michael Baker, Jr., Inc., in March 1981. These revisions have been incorporated into this study.

The hydrologic and hydraulic analyses for the reach of Coal Creek south of the Union Pacific Railroad were performed by U.S. Department of the Interior, Bureau of Reclamation, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-87-E-2551. This study was completed in August 1988.

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

1.3 Coordination

Initial meetings to identify streams requiring detailed study within the Town of Erie were held on March 31 and April 16, 1976. These meetings were attended by representatives of the Colorado Water Conservation Board (CWCB), FEMA, the Weld County Planning Department, and Gingery Associates, Inc. (GAI). Another meeting was held on January 28, 1977, attended by representatives of FEMA, the Mayor and Town Clerk of Erie, and GAI. The purpose of this meeting was to gather flooding information and outline the study procedures for the reach of Coal Creek north of the Union Pacific

Railroad near Perry Street. The U.S. Soil Conservation Service (SCS) was also contacted for information concerning flood hazards.

A final coordination meeting for this reach of the study was held on November 7, 1977. The meeting was attended by FEMA, officials from the Town of Erie, local interested groups, and GAI.

On October 6, 1987, a meeting was held between representatives of FEMA, the Town of Erie, and the U.S. Department of the Interior, Bureau of Reclamation. The purpose of this meeting was to discuss the detailed analysis of flood hazards along Coal Creek, south of the Union Pacific Railroad. The Town of Erie provided maps, which were used in the analysis.

In addition, the SCS, U.S. Geological Survey, U.S. Army Corps of Engineers (COE), and the CWCB were contacted for pertinent technical information regarding flood hazards within the Town of Erie. The SCS provided a copy of their Flood Hazard Analysis, "Coal Creek and Rock Creek, Boulder, and Weld Counties, Colorado," dated October 1976. The SCS also provided hydraulic backwater computer model input data for Coal Creek near Erie. The USGS provided copies of Flood Prone Area Maps for the study area. The COE indicated that they had no pertinent technical information that could be included in the Coal Creek study.

The CWCB provided a copy of the Technical Addendum, "Floodplain Information, Flood Control and Floodplain Management Plan for Coal Creek at Erie, Colorado," prepared by Water Resource Consultants, Inc. (WRC), dated August 1980. The addendum contained copies of the HEC-2 computer modeling for a portion of the study area. Robinson Engineering, Inc. (REI), was contacted in response to a recommendation from the Town of Erie. REI provided detailed topographic mapping for a portion of the study area.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the Town of Erie, Colorado. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989. Floods caused by Coal Creek and the Coal Creek West Line Overflow were studied in detail.

2.2 Community Description

The Town of Erie is approximately 40 miles north of Denver, in the southwest corner of Weld County and the northeast corner of Boulder County, in north-central Colorado.

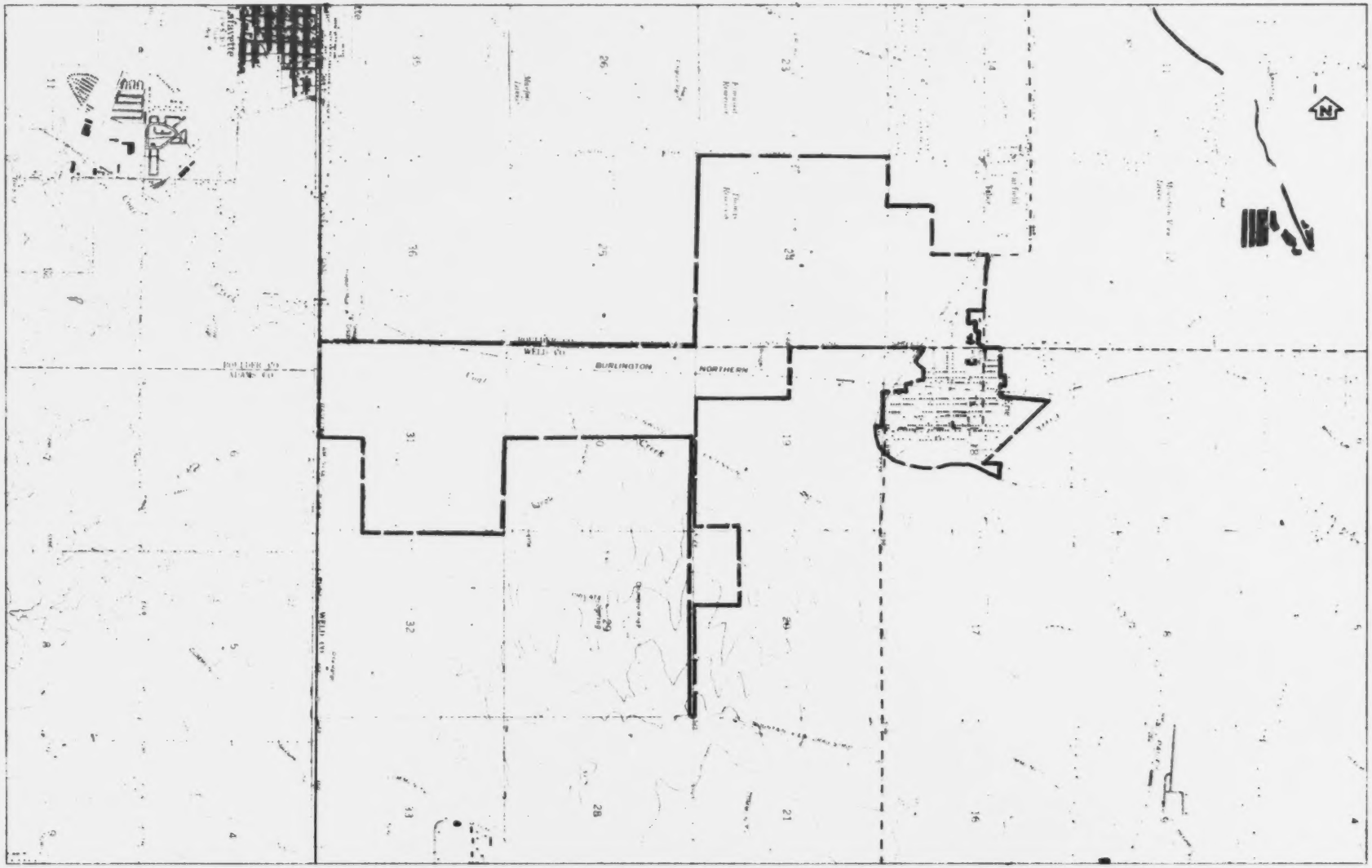


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COS.)

APPROXIMATE SCALE
4000 0 4000 8000 12,000 FEET

VICINITY MAP

In the late 1800s, coal mining led to the development of Erie and several other small communities along the banks of Coal Creek. Because the coal reserves have diminished and most of the mines have been shut down, Erie is now mostly commercial and residential, with some agricultural development in the surrounding area (Reference 1). The estimated population of Erie was 1,231 in 1980 (Reference 2).

The average annual precipitation in Erie is 12.7 inches, and the normal mean temperature is 48.6°F. In 1976, the temperature varied from a July average of 71.6°F to a January average of 26.8°F (Reference 3).

Vegetation in the area consists primarily of native grass. The soils in the area are shallow, very gravelly and stoney, and in the rock outcrop-Juget-Baller Association (Reference 1).

The topography in the developed part of Erie is relatively flat and gradually slopes toward Coal Creek. Both residential and commercial development exist in the floodplain area.

Coal Creek flows northerly along Erie's eastern corporate limits and empties into Boulder Creek.

Coal Creek West Line Overflow begins where floodwaters from Coal Creek overtop the Union Pacific Railroad south of Erie and flow northerly independent of Coal Creek, through the fully developed area of Erie, returning to Coal Creek north of the town.

2.3 Principal Flood Problems

The main sources of flooding on Coal Creek are heavy thunderstorms in spring and summer. Flooding can become especially severe when these thunderstorms follow either rapid snowmelt or prolonged rainy weather (Reference 1).

Floods have occurred in 1876, in 1891, in June 1896, on June 3, 1921, on May 26, 1935, on September 2, 1938, on June 9, 1949, on May 9, 1957, and in May 1969. The estimated discharges for these events at Erie are shown below (Reference 1).

Date of Flood	Discharge at Erie (Cubic Feet per Second)	Approximate Frequency
1876	13,200	100-Year
June 3, 1921	7,800	20-Year
September 2, 1938	3,500	5-Year

Amount of damage from these floods is unknown. Flood discharges were estimated by the COE using the slope-area method.

The 1876 flood is the maximum flood of record at Erie. The most recent flood occurred in May 1969.

2.4 Flood Protection Measures

No structures provide flood protection in the Town of Erie.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The peak discharges for the 10-, 50-, 100-, and 500-year floods for Coal Creek used in this study were developed by the SCS in a report entitled Flood Hazard Analyses, Coal Creek and Rock Creek, Boulder and Weld Counties, Colorado (Reference 1). The SCS used synthetic rainfall-runoff procedures, as described in the SCS's National Engineering Handbook (Reference 4), and the TR-20 computer program for flood routing (Reference 5) in order to establish the selected discharges along the stream.

Peak discharge-drainage area relationships for Coal Creek are shown in Table 1.

Analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross section data for Coal Creek in the area north of the Union Pacific Railroad were obtained from topographic maps at a scale of 1:4800, with contour intervals of 2 and 4 feet (Reference 6). Field measurements were taken by the SCS to obtain elevation data and structural geometry of all bridges and culverts.

Roughness coefficients (Manning's "n") for Coal Creek north of the railroad were determined by the SCS through field inspections. The "n" values range from 0.085 to 0.120 for the existing channel and overbanks areas.

Roughness coefficients for Coal Creek south of the railroad were determined by the WRC (Reference 7). These values were reviewed and approved by the CWCB. The "n" values range from 0.075 in the channel to 0.055 in the overbank.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations for floods of the selected recurrence intervals on Coal Creek and the Coal Creek West Line Overflow were computed through use of the COE HEC-2 step-backwater computer program (Reference 8).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream

TABLE 1. SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Year	50-Year	100-Year	500-Year
Coal Creek					
Near Tri-County Airport	68.61	5,970	9,670	11,850	17,860
At Union Pacific Railroad near Erie	76.86	6,160	10,020	12,250	18,340
At Briggs Street	77.48	6,160	10,040	12,280	18,380
Coal Creek West Line Overflow					
At Union Pacific Railroad near Erie	-----	1,500	3,770	4,900	8,050
At Cheesman Street	-----	1,510	3,790	4,920	8,100

studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4800, with a contour interval of 2 and 4 feet (Reference 6).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Coal Creek								
A	13,244	646[2]	2,623	4.7	5,006.7	5,006.7	5,007.7	1.0
B	13,684	529[2]	2,265	5.4	5,008.4	5,008.4	5,009.4	1.0
C	13,914	702[2]	2,250	5.5	5,009.9	5,009.9	5,010.8	0.9
D	13,946	913[2]	3,708	3.3	5,011.0	5,011.0	5,011.9	0.9
E	14,326	620[2]	2,979	4.1	5,011.5	5,011.5	5,012.5	1.0
F	15,026	753	2,965	4.1	5,012.9	5,012.9	5,013.9	1.0
G	15,666	154	1,362	5.4	5,014.9	5,014.9	5,015.6	0.7
H	16,641	157	1,086	6.8	5,018.7	5,018.7	5,018.9	0.2
I	17,561	157	1,416	5.2	5,020.9	5,020.9	5,021.1	0.2
J	17,971	150	1,369	5.4	5,021.4	5,021.4	5,021.6	0.2
K	18,306	90	853	8.6	5,021.7	5,021.7	5,021.9	0.2
L	33,270	709	3,864	3.2	5,059.7	5,059.7	5,060.4	0.7
M	35,040	512	2,320	5.3	5,062.9	5,062.9	5,063.9	1.0
N	36,660	1,197	3,474	3.4	5,069.7	5,069.7	5,069.7	0.0
O	38,420	715	2,529	4.7	5,073.6	5,073.6	5,074.6	1.0
P	40,490	616	2,947	4.0	5,079.5	5,079.5	5,080.5	1.0
Q	41,730	175	1,599	7.4	5,084.2	5,084.2	5,085.2	1.0
R	44,170	811	3,889	3.0	5,089.4	5,089.4	5,090.4	1.0
S	46,360	135	1,700	6.8	5,093.1	5,093.1	5,093.6	0.5

[1]Feet Above Mouth
[2]This Width is Entirely Outside Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COUNTIES)

FLOODWAY DATA

COAL CREEK AND COAL CREEK WEST LINE OVERFLOW

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Coal Creek West Line Overflow								
A	800	497	946	5.2	5,014.5	5,014.5	5,015.2	0.7
B	1,750	526	1,181	4.2	5,018.7	5,018.7	5,019.7	1.0
C	2,740	569	1,202	4.1	5,022.3	5,022.3	5,023.2	0.9
D	3,220	527	1,532	3.2	5,023.4	5,023.4	5,024.4	1.0
E	3,695	304	743	6.6	5,025.1	5,025.1	5,025.7	0.6

[1]Feet Above Mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COUNTIES)

FLOODWAY DATA

COAL CREEK AND COAL CREEK WEST LINE OVERFLOW

without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

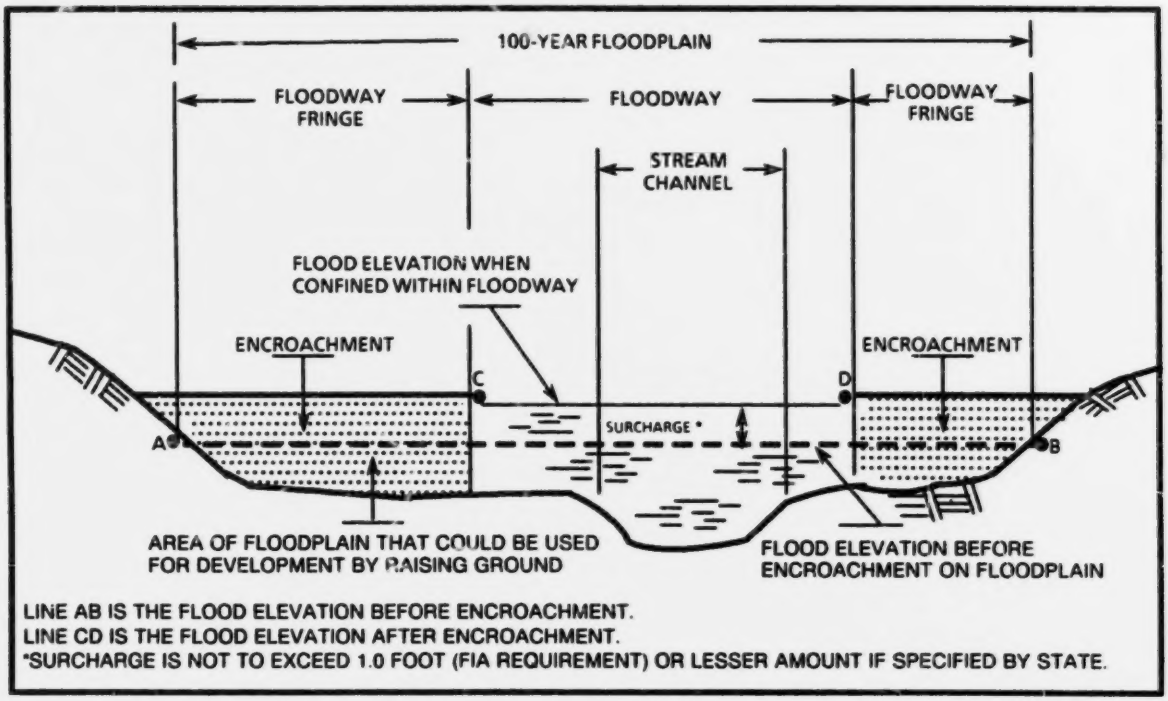

100-YEAR FLOODPLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE *
AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from

the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

A report concerning the potential flood hazards of Coal Creek in the area around the Town of Erie, entitled Flood Hazard Analyses, Coal Creek and Rock Creek, was prepared in October 1976 by the SCS (Reference 1). That report was modified in August 1980 by WRC in their report entitled Floodplain Information, Flood Control and Floodplain Management. This Flood Insurance Study is integrated with that study, north of Briggs Street; however, new HEC-2 runs south of Briggs Street were developed for the Coal Creek West Line Overflow and Coal Creek, and supersede that portion of the above-mentioned WRC study.

This report supersedes the previous Flood Insurance Study (Reference 9) and should be considered authoritative for purposes of the Flood Insurance Program.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of Agriculture, Soil Conservation Service, Flood Hazard Analyses, Coal Creek and Rock Creek, Boulder and Weld Counties, Colorado, October 1976.

2. U.S. Department of Commerce, Bureau of the Census, "1980 Census of Population, Number of Inhabitants, Colorado," 1981.

3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, Colorado Annual Summary, Vol. 80, No. 13, 1976.

4. U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Hydrology, Section 4, August 1972.

5. _____, Engineering Division, Central Technical Unit, Technical Release No. 20, Computer Program for Project Formulation, May 1965.

6. Water Resources Consultants, Inc., Topographic Maps, Coal Creek, Boulder and Weld Counties, Colorado, compiled by photogrammetric methods, Scale 1:4800, Contour Interval 2 and 4 feet: February 1980.

7. Water Resources Consultants, Inc., Floodplain Information, Flood Control and Floodplain Management Plan for Coal Creek at Erie, Colorado, and Technical Addendum, August 1980.

8. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, 1973.

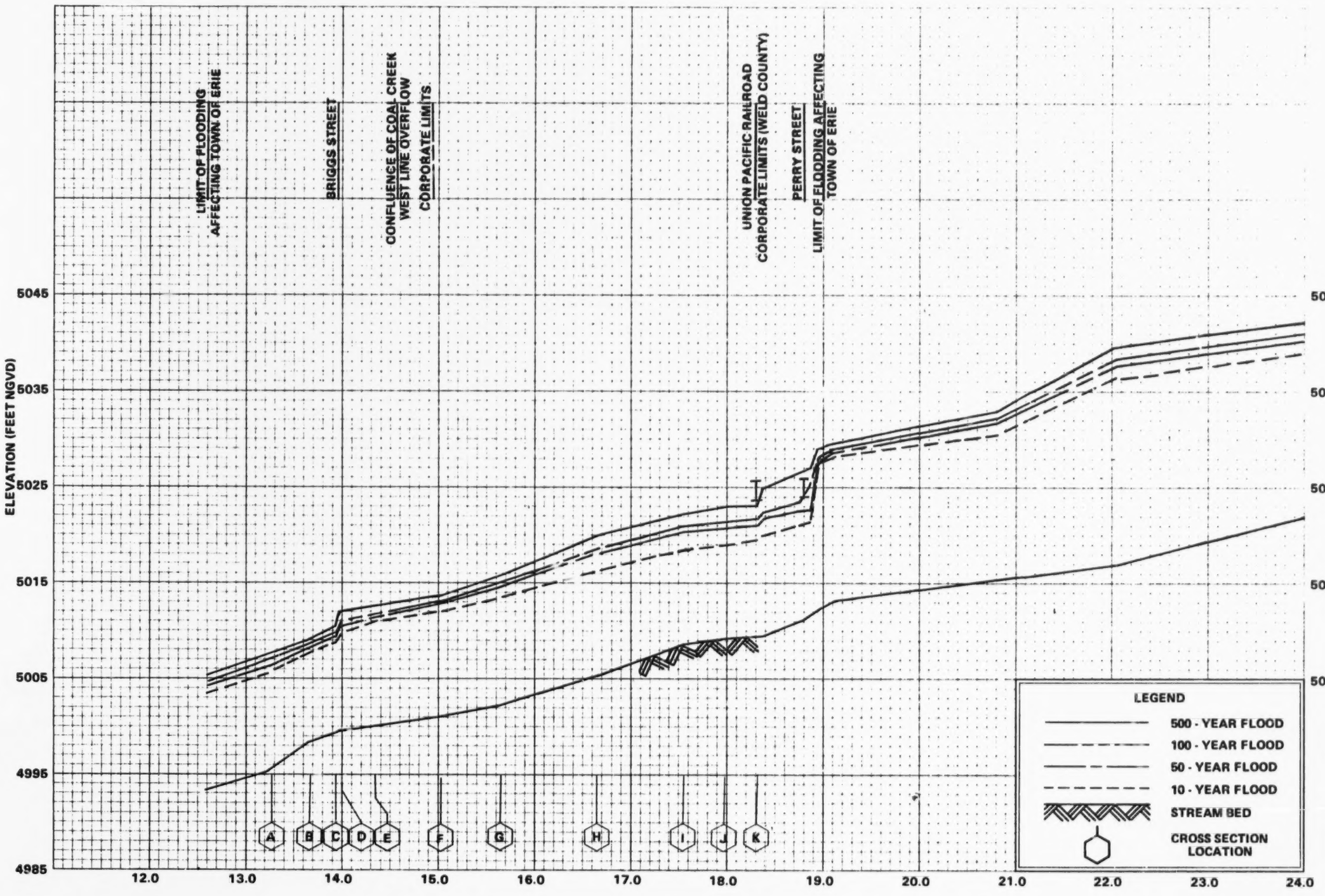
9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Erie, Colorado, September 1982.

10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Rate Map, Weld County, Colorado, Scale 1:24,000, March 18, 1980.

11. Town of Erie, Comprehensive Plan Area Map, prepared by King and Associates, Inc., June 30, 1987.

12. Robinson Surveying and Engineering Company, Topographic Maps, Erie Tech Center Preliminary Plat, 1:1200, Contour Interval of 2 feet, undated.

13. Town of Erie Zoning Map, 1:9600, March 20, 1987.



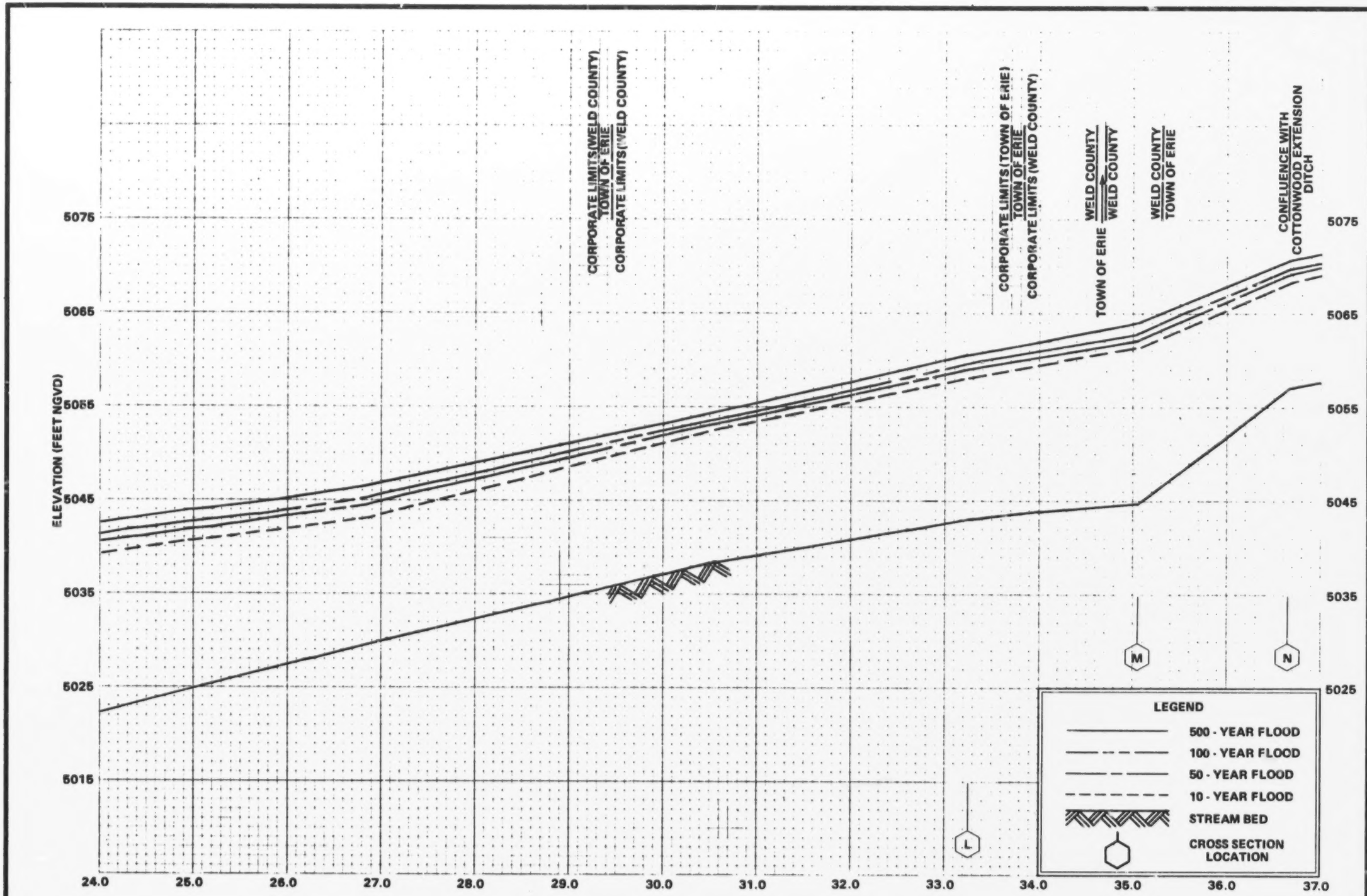
FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COS.)

01P



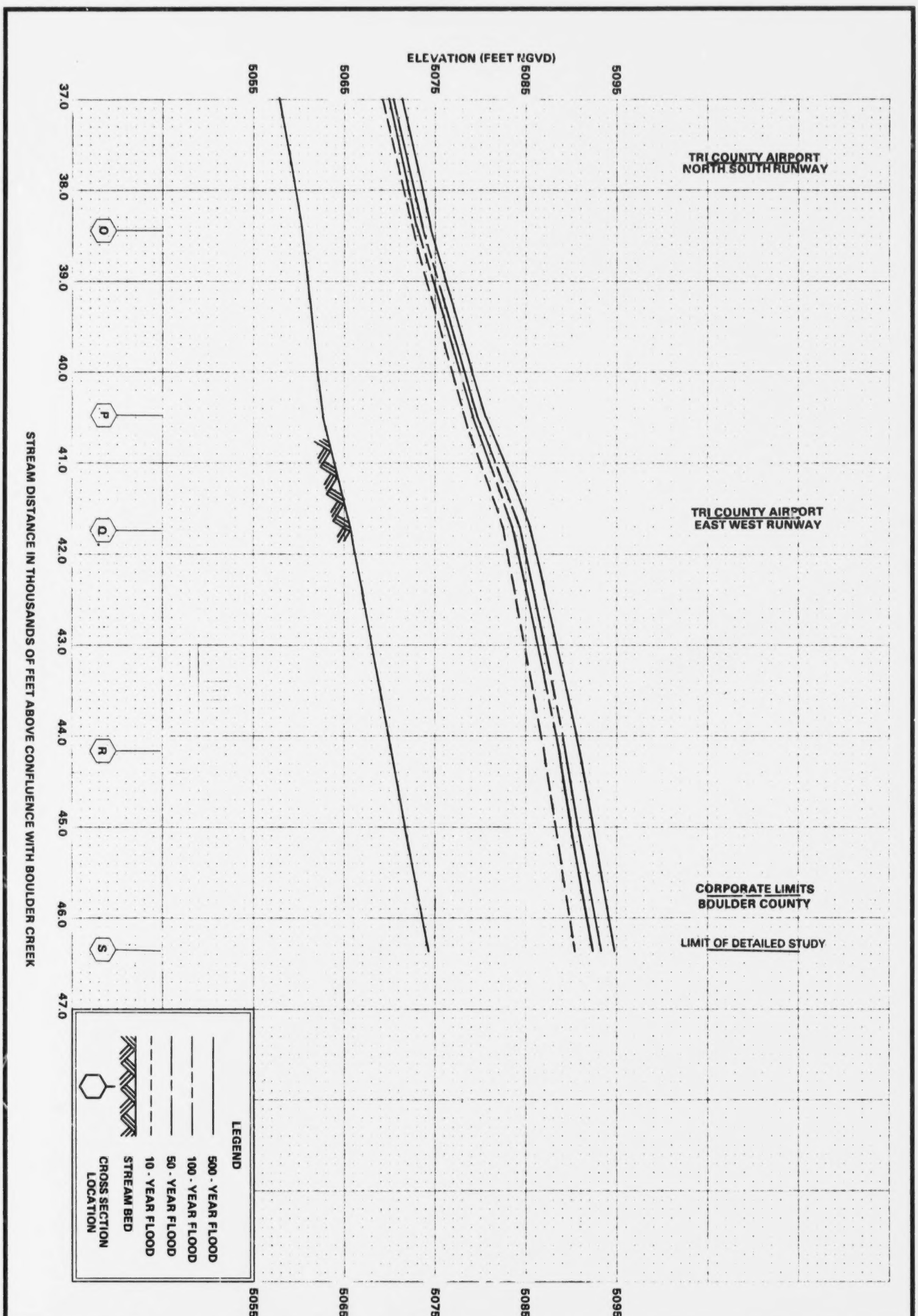
FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COS.)

02P



16

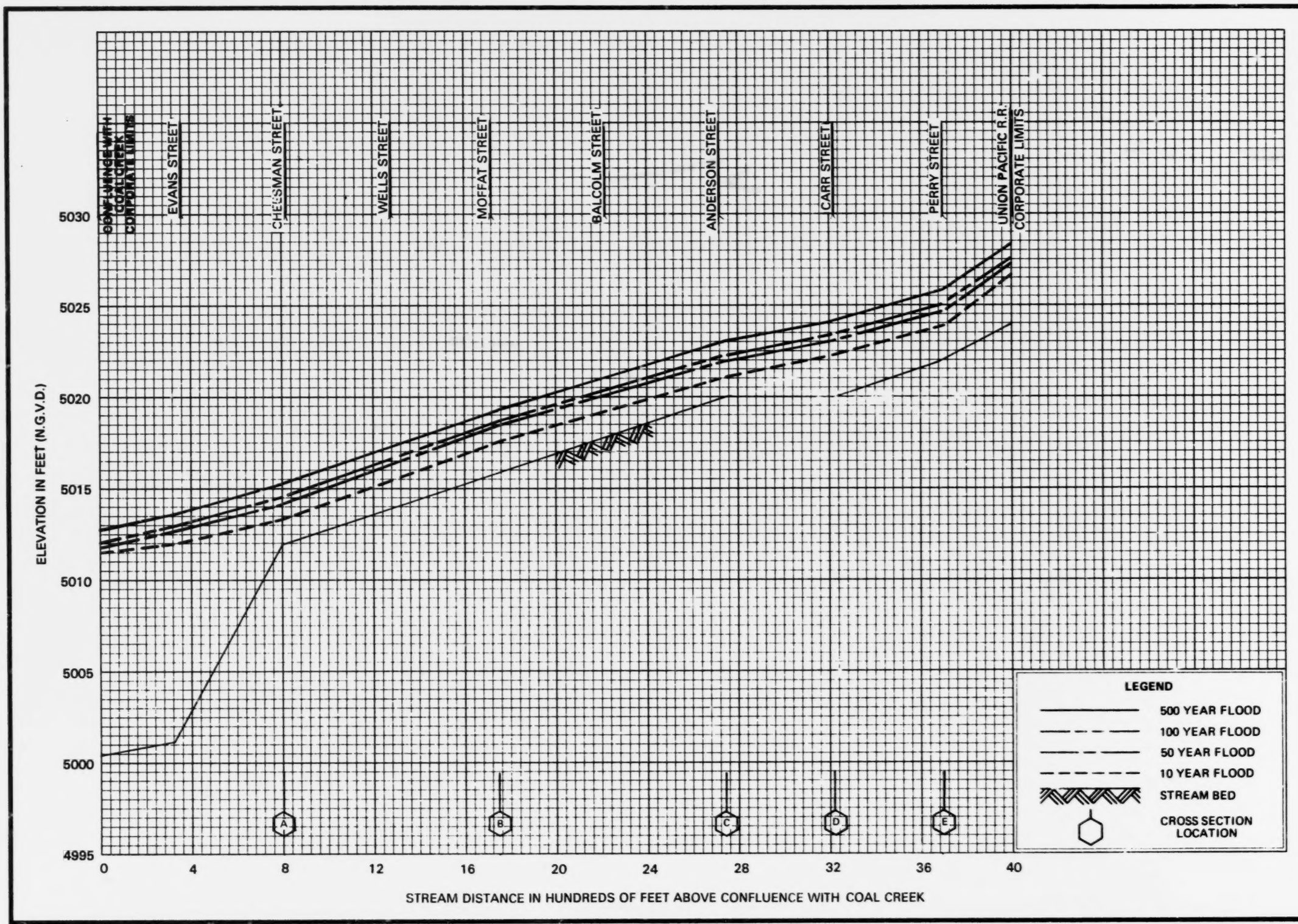
03P

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COS.)

FLOOD PROFILES

COAL CREEK



FLOOD PROFILES

COAL CREEK (WEST LINE OVERFLOW BASELINE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ERIE, CO
(BOULDER AND WELD COS.)

04P

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (feet NGVD)	Description of Location
RM1	5,024.95	Cap and rebar, located 2 feet south of a street sign (Pierce and Perry Streets), 13 feet southwest of a fire hydrant, and 37 feet northwest of the intersection of Pierce and Perry Streets. Established by the U.S. Soil Conservation Service.